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(54) **STEERING WHEEL ASSEMBLY WITH COVERED LIGHT SOURCE**

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See application file for complete search history.

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(56) **References Cited**

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U.S. PATENT DOCUMENTS

(73) Assignee: **Joyson Safety Systems Acquisition LLC**, Auburn Hills, MI (US)

6,296,380	B1 *	10/2001	Dawli	B60Q 3/283	362/224
7,934,439	B2	5/2011	Bostick		
8,136,425	B2	3/2012	Bostick		
8,296,012	B2	10/2012	Cech et al.		
9,233,638	B2	1/2016	Lisseman et al.		
9,308,856	B2 *	4/2016	Lisseman	B60Q 3/283	
9,308,857	B2	4/2016	Lisseman et al.		
9,481,297	B2 *	11/2016	Salter	B62D 15/029	
9,520,061	B2	12/2016	Cech et al.		
9,580,012	B2	2/2017	Lisseman et al.		
D806,729	S	1/2018	Lisseman et al.		

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B60Q 3/64	(2017.01)
B62D 1/06	(2006.01)
B62D 1/04	(2006.01)

(52) **U.S. Cl.**

CPC **B60Q 3/283** (2017.02); **B60Q 3/64** (2017.02); **B62D 1/04** (2013.01); **B62D 1/06** (2013.01); **B62D 1/065** (2013.01)

(58) **Field of Classification Search**

CPC . B60Q 3/283; B60Q 3/64; B60Q 3/62; B60Q 3/66; B62D 1/06; B62D 1/04; B62D 1/065

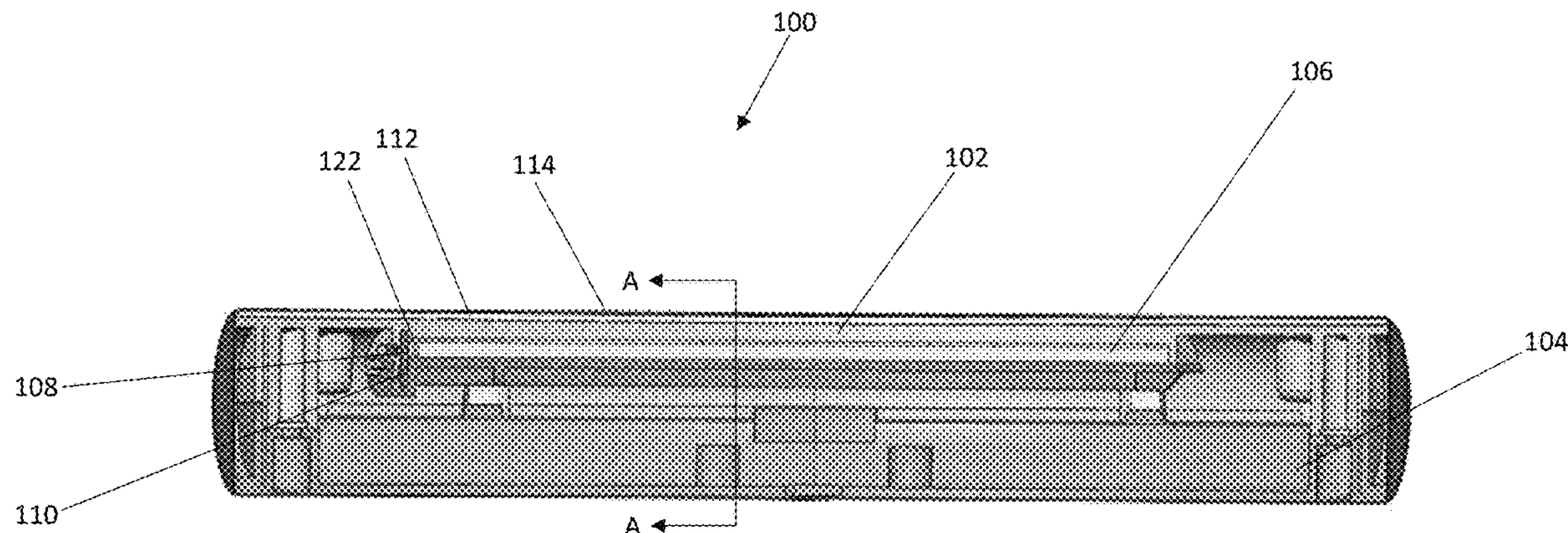
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(57) **ABSTRACT**

An illumination system for a steering wheel assembly of a vehicle including a housing coupled to a rim of the steering wheel assembly. At least one visible light source is disposed adjacent the housing and emitting visible light through an opening in the housing. A lens is provided covering the opening in the housing such that an inner surface of the lens is disposed adjacent the opening in the housing. A cover material covers the outer surface of the lens and at least a portion of the rim, and includes translucent and/or transparent portions such that the lens is not visible through the cover material. The visible light from the visible light source passes through the transparent and/or translucent portions of the cover material.

21 Claims, 10 Drawing Sheets



(56)

References Cited

U.S. PATENT DOCUMENTS

9,873,446	B2 *	1/2018	Gardner	B60Q 9/00
10,011,222	B1 *	7/2018	Wu	F21S 9/04
D847,190	S	4/2019	Lisseman et al.	
10,793,063	B1 *	10/2020	Samuel, Jr.	B60Q 3/80
2001/0010179	A1 *	8/2001	Ku	B62D 1/06
				74/558
2007/0153535	A1 *	7/2007	Bostick	B60Q 3/283
				362/488
2008/0202282	A1 *	8/2008	Bassett	B62D 1/06
				74/552
2010/0107806	A1 *	5/2010	Corinaldi	B62D 1/046
				74/552
2014/0301097	A1	10/2014	Neumann et al.	
2015/0123947	A1 *	5/2015	Jubner	B60K 37/06
				345/175
2016/0025281	A1	1/2016	Gardner et al.	
2016/0200246	A1	7/2016	Lisseman et al.	
2016/0200343	A1	7/2016	Lisseman et al.	
2016/0311366	A1	10/2016	Lisseman	
2018/0208111	A1	7/2018	Lisseman et al.	
2020/0001782	A1 *	1/2020	Kamei	B60Q 3/64

* cited by examiner

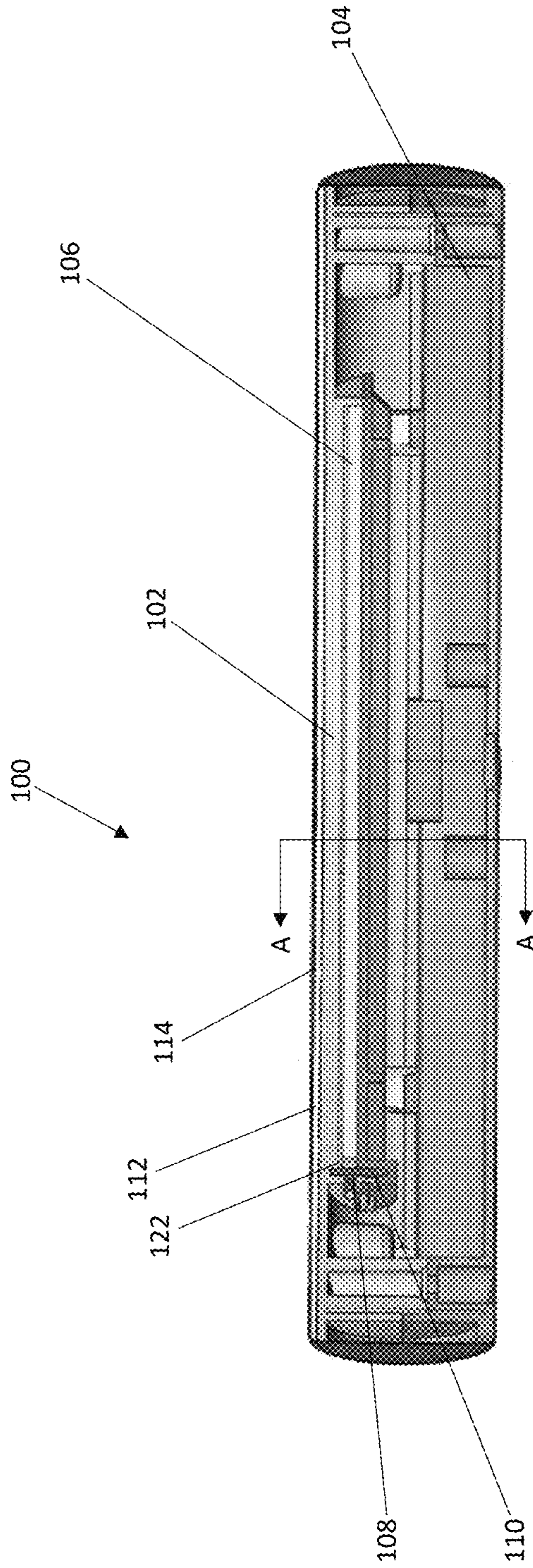


FIG. 1

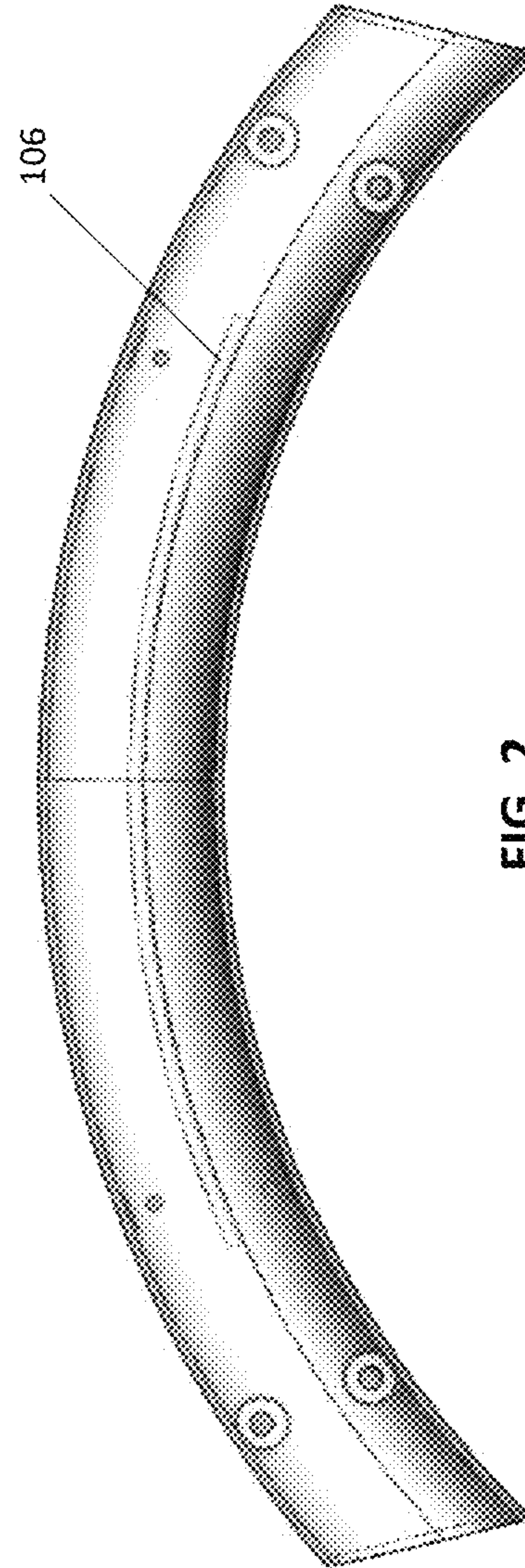


FIG. 2

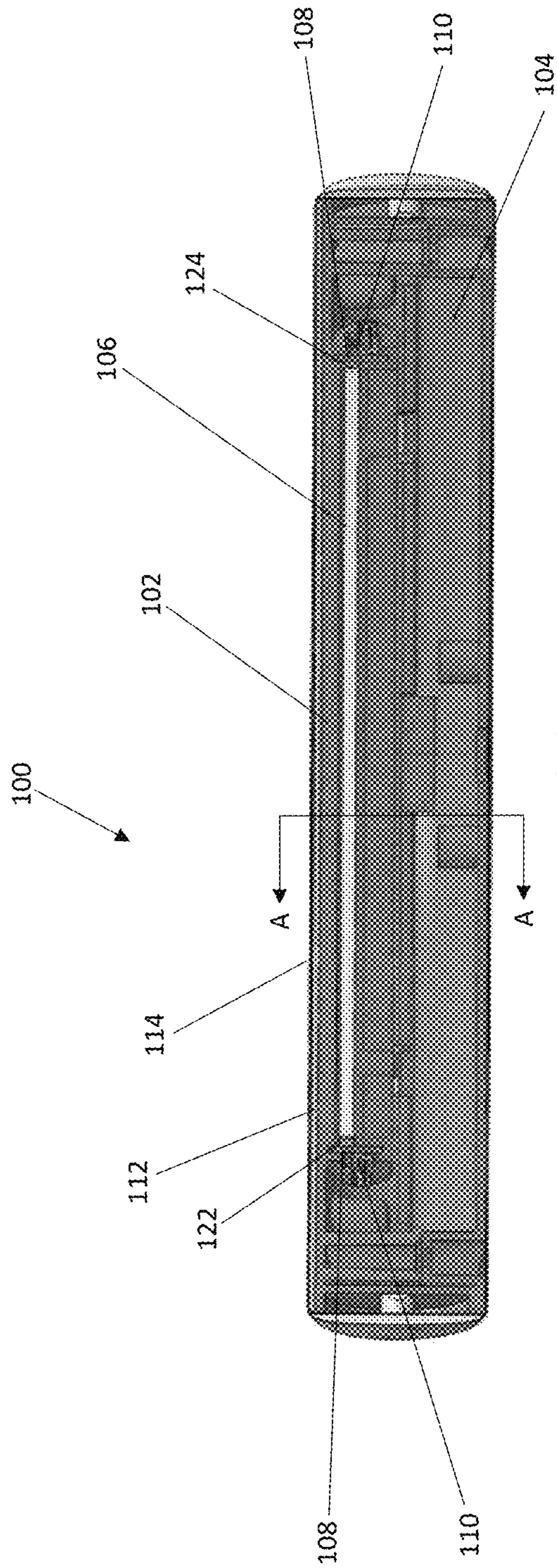


FIG. 3

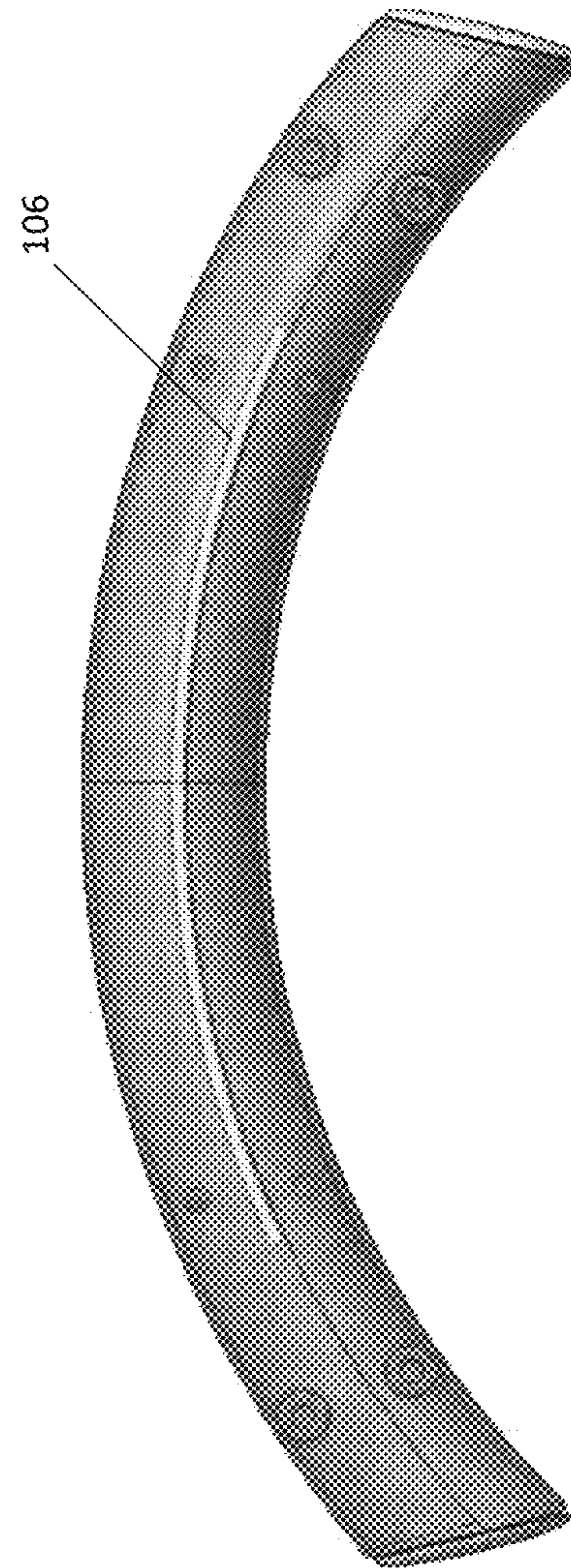


FIG. 4

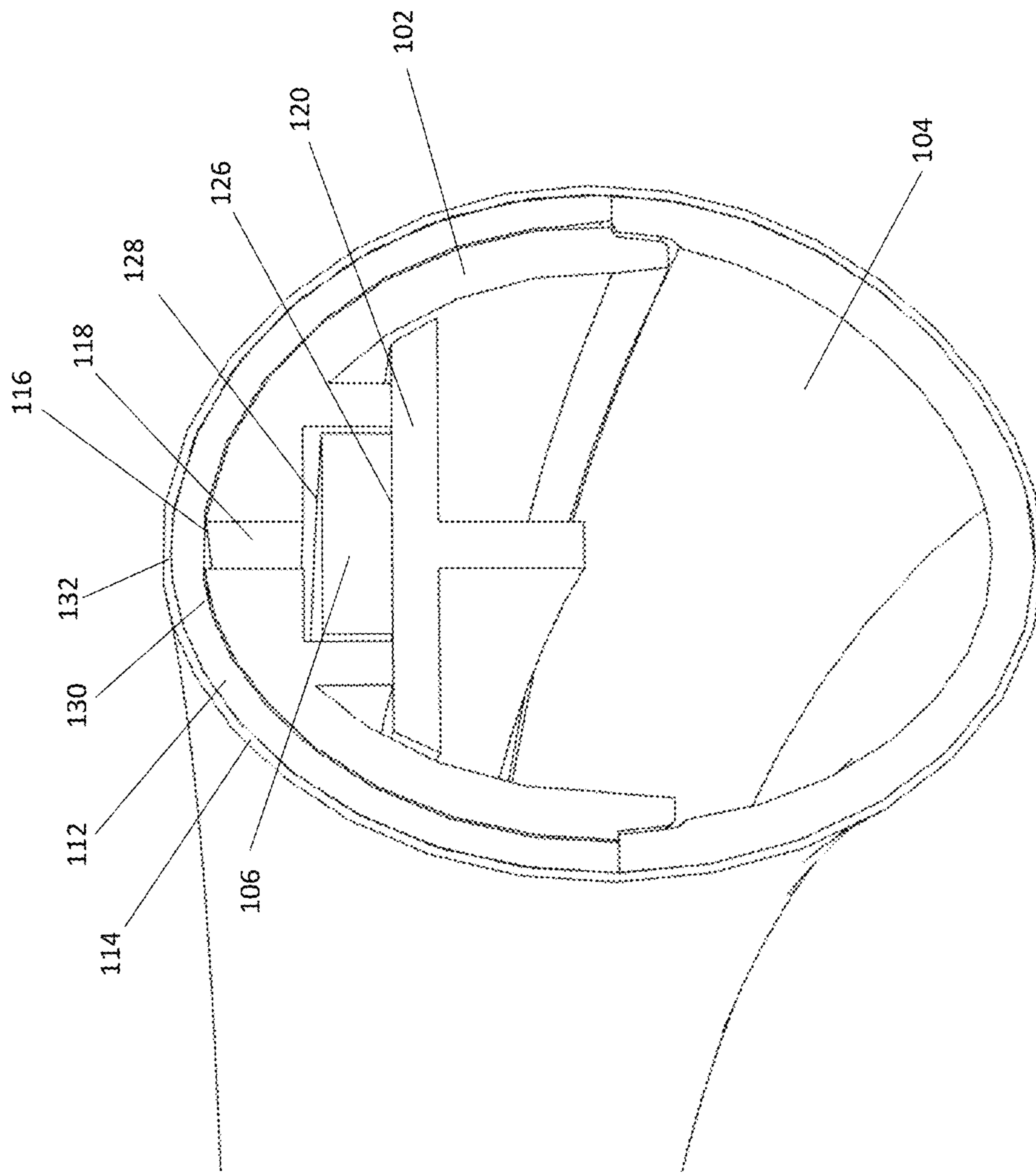


FIG. 5

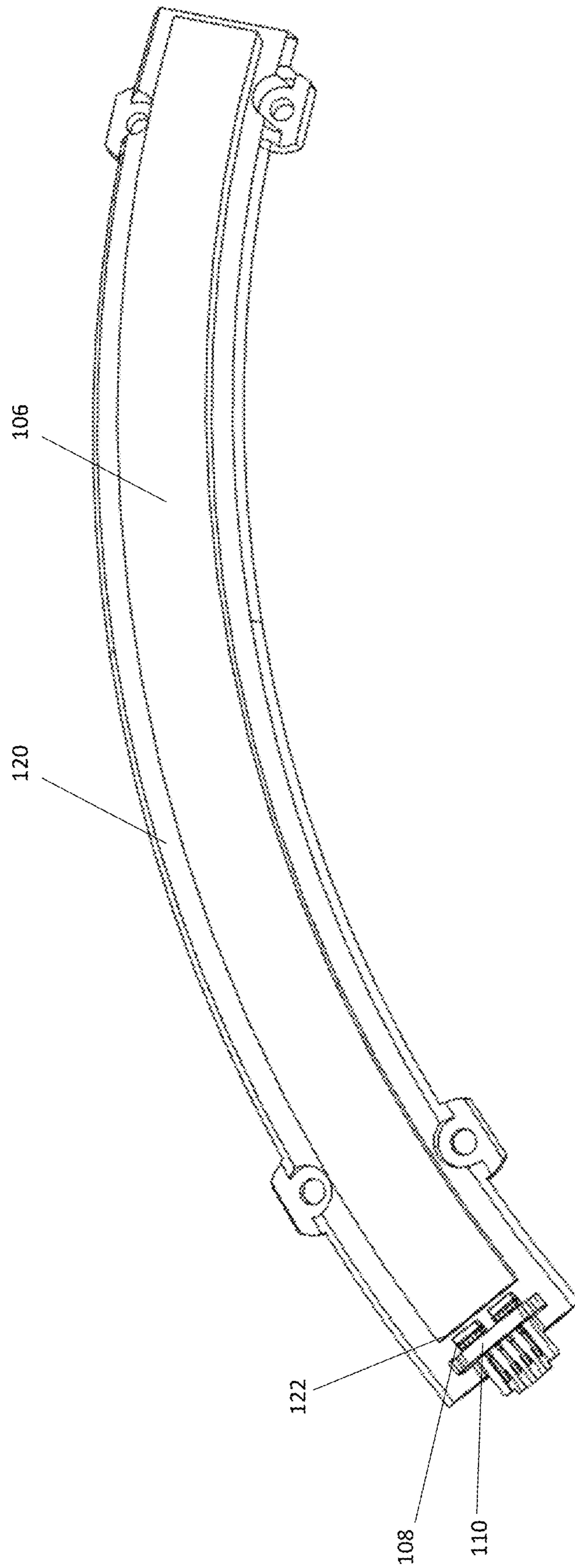


FIG. 6

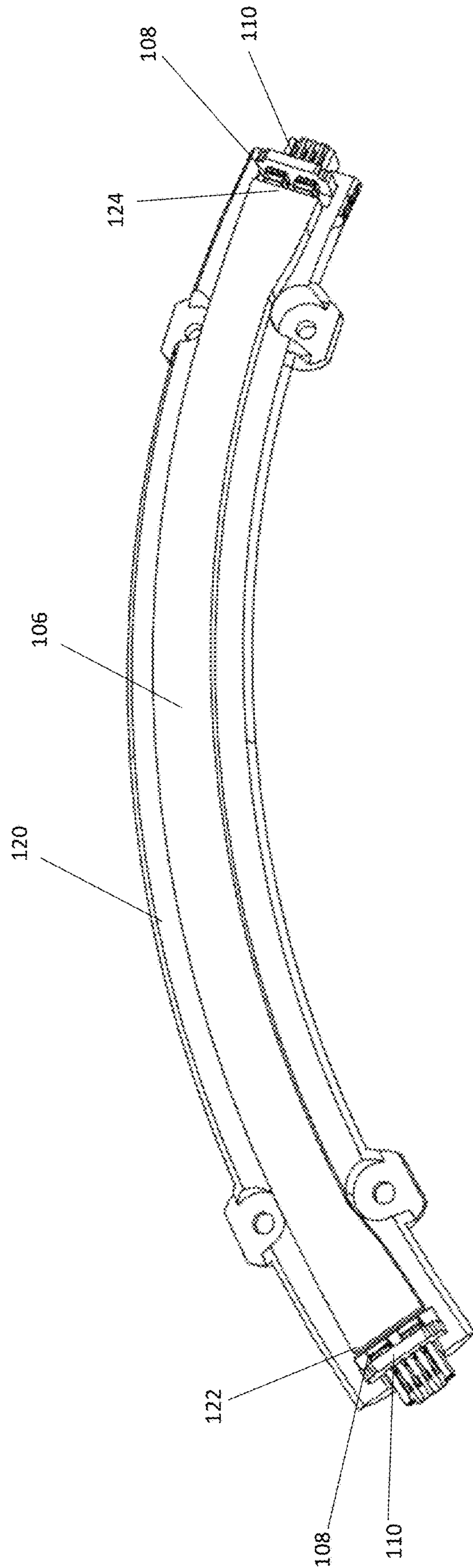


FIG. 7

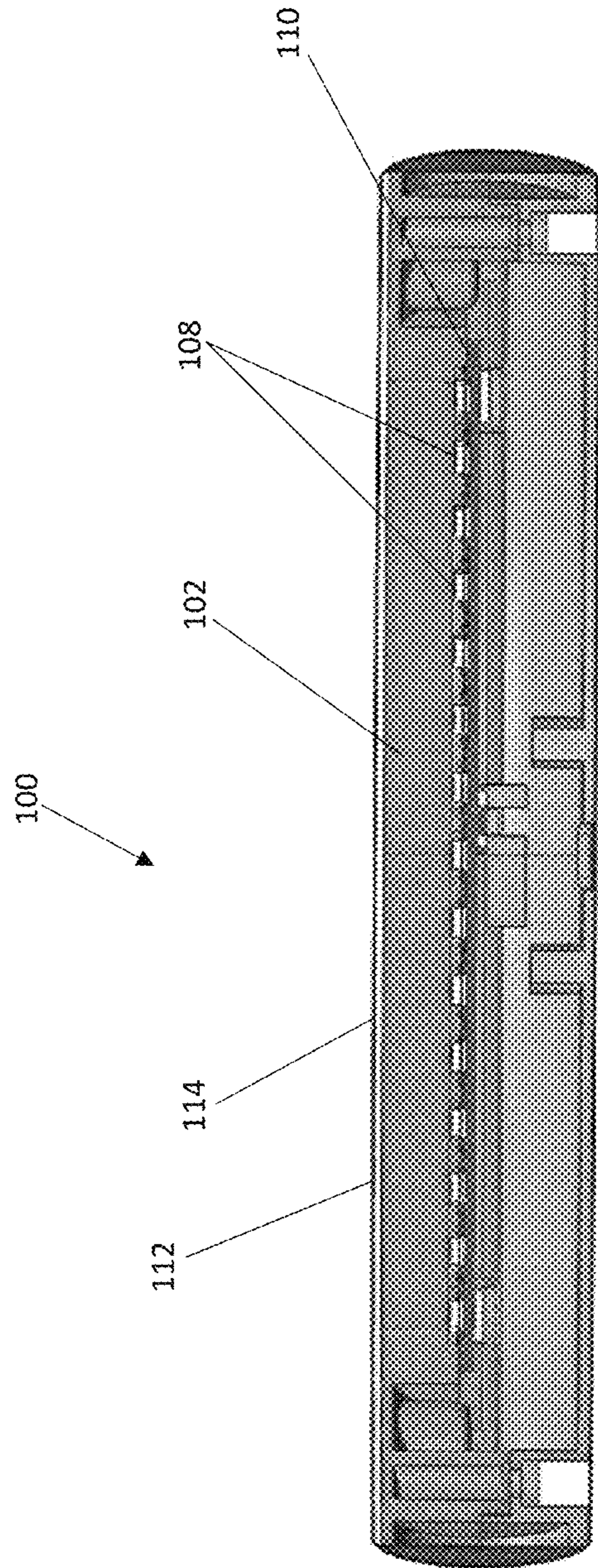


FIG. 8

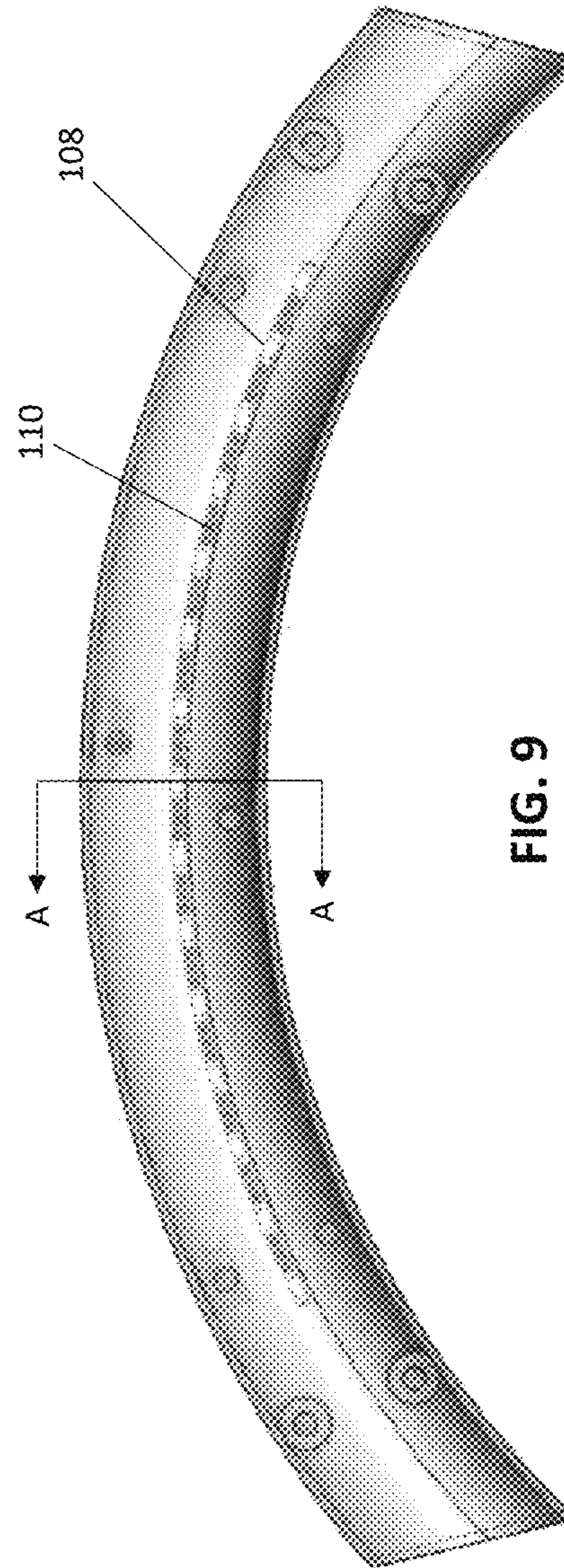


FIG. 9

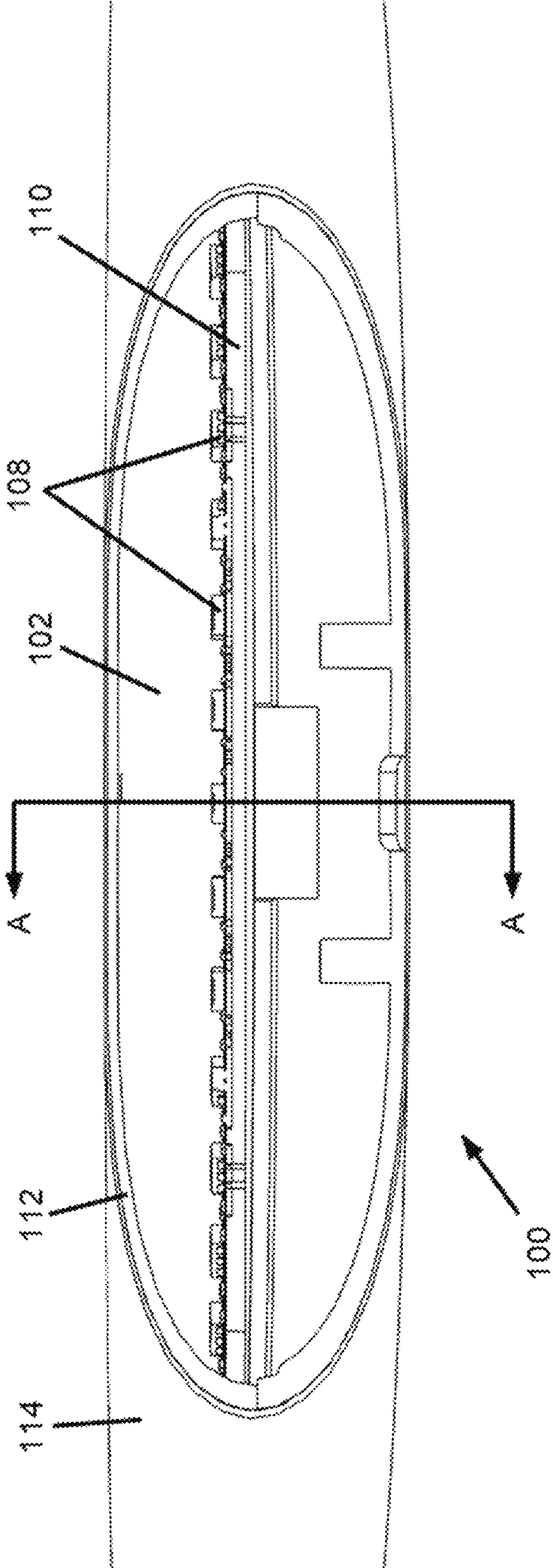


FIG. 10

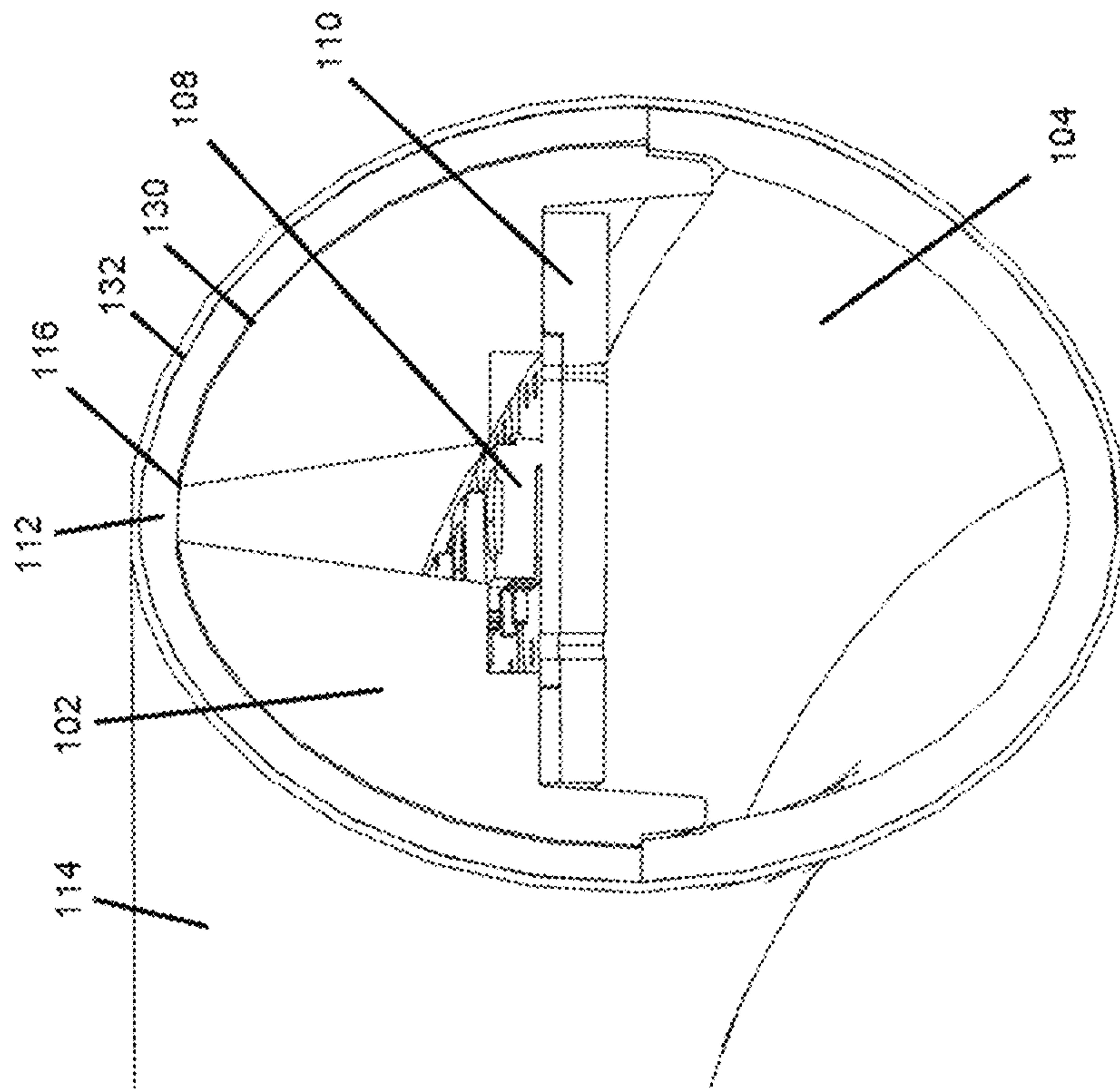


FIG. 11

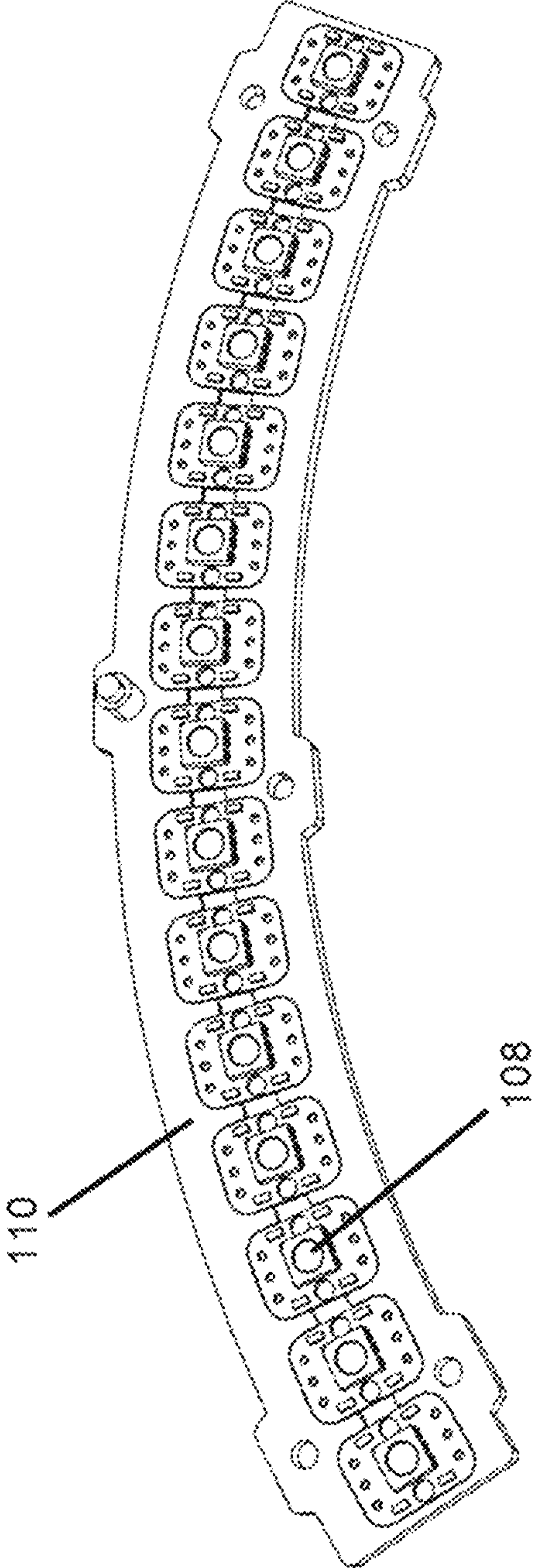


FIG. 12

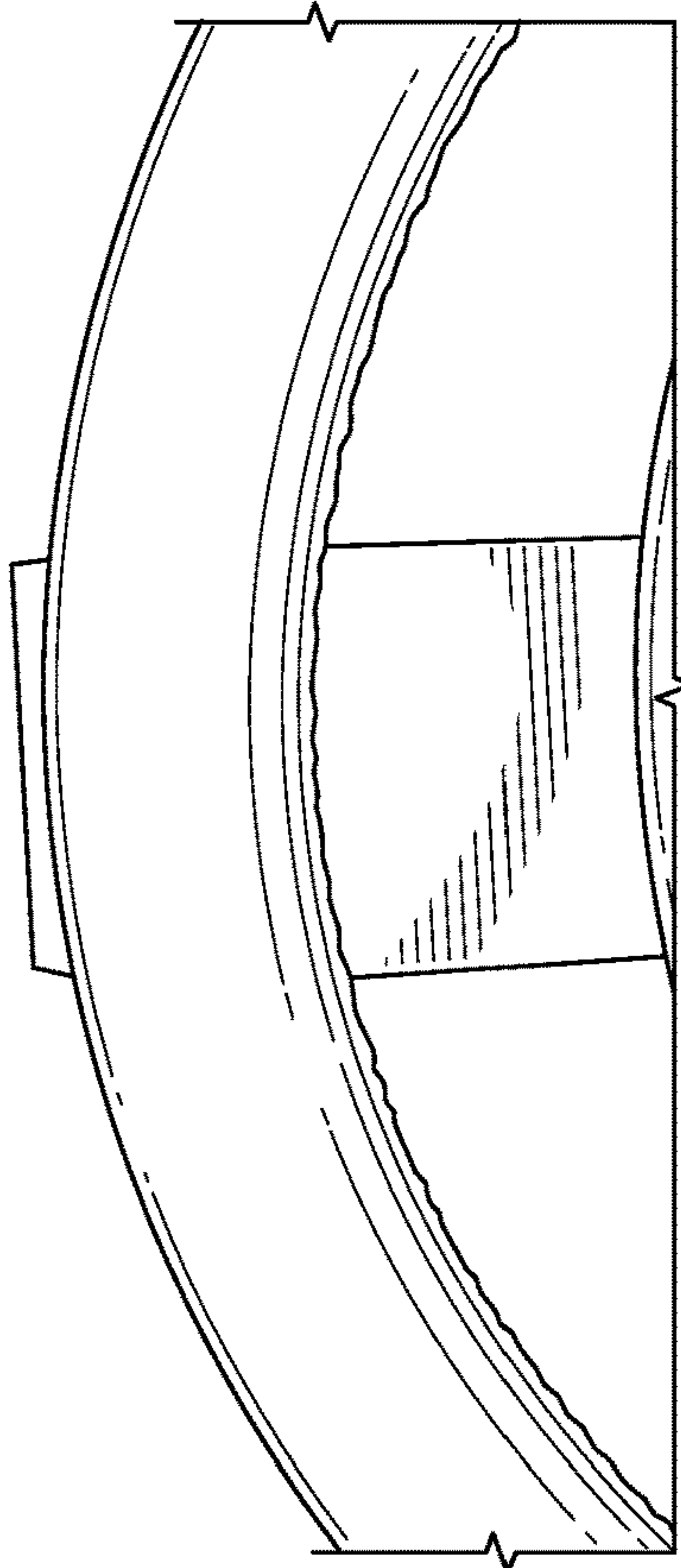


FIG. 13

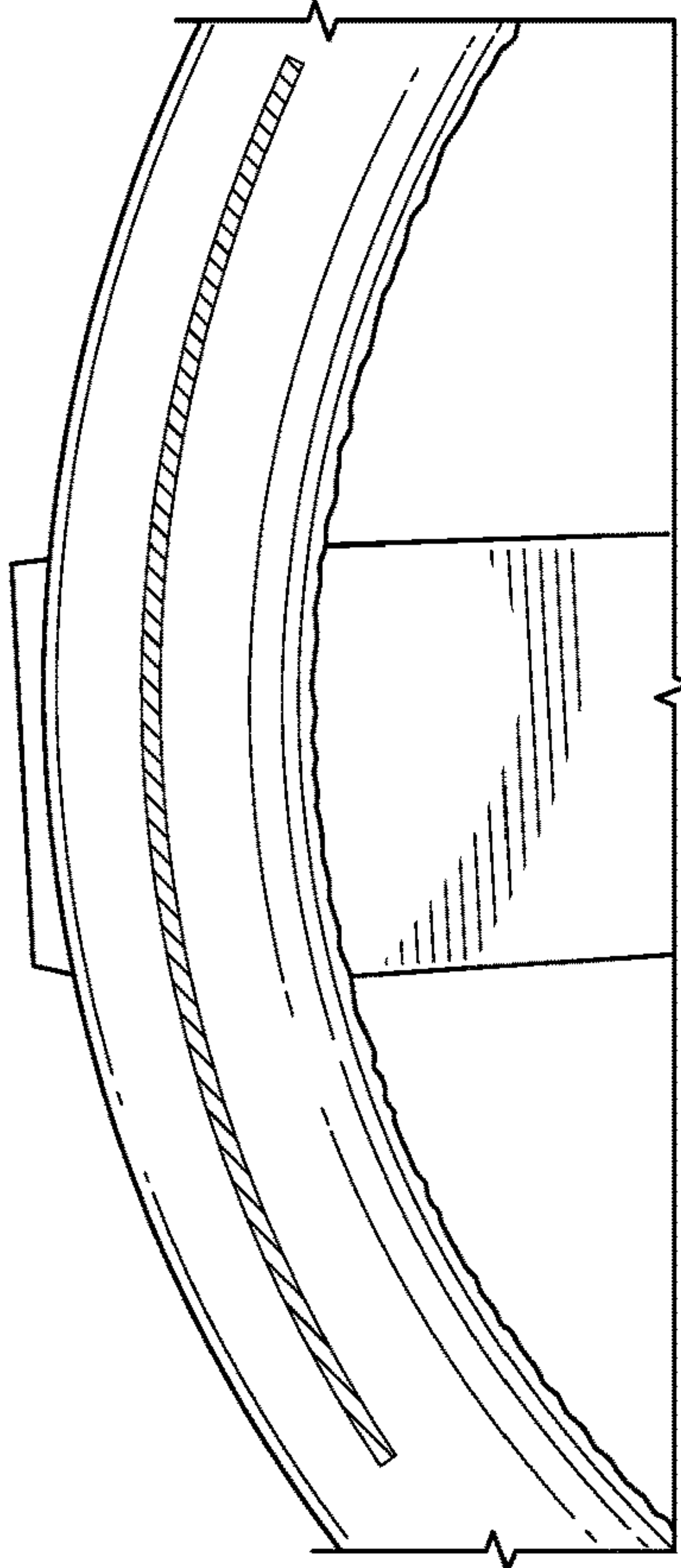


FIG. 14

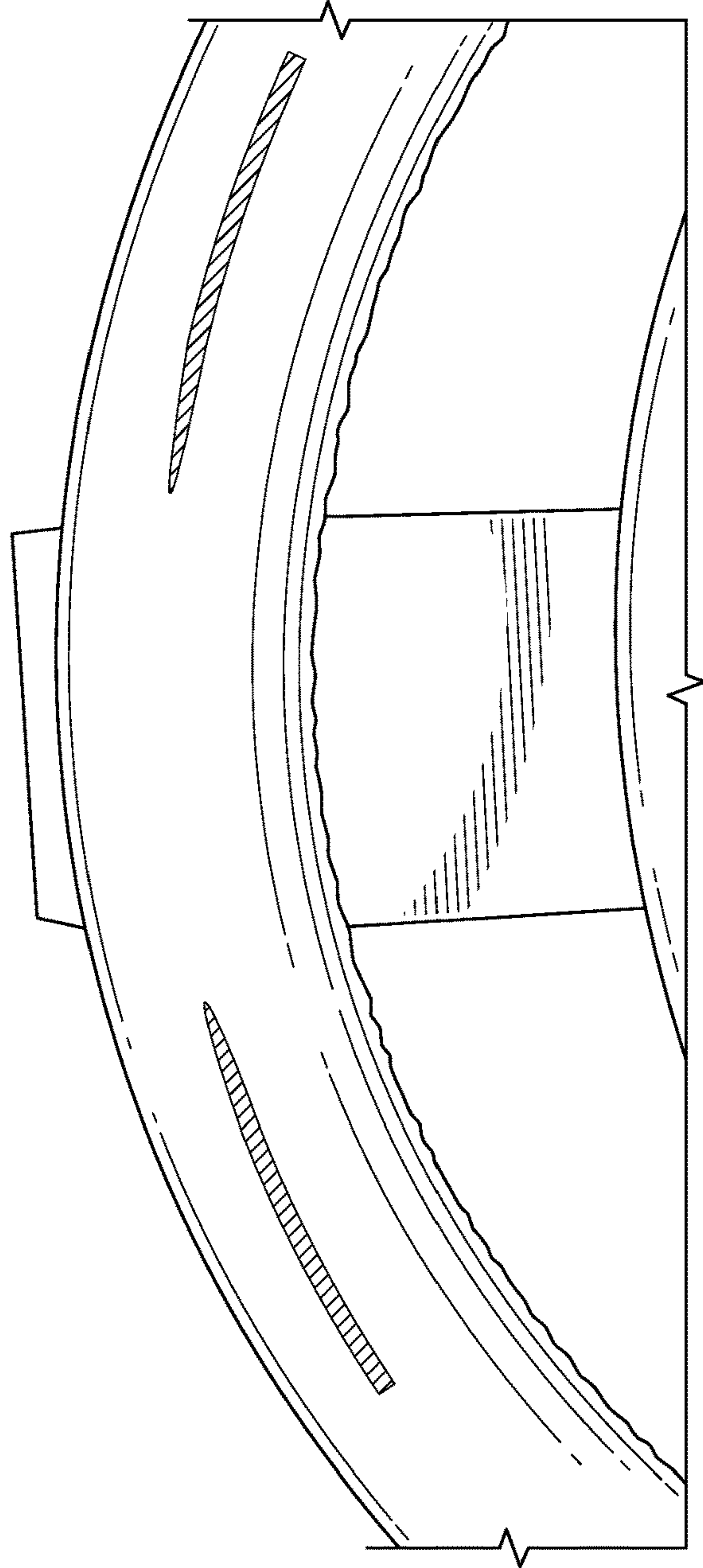


FIG. 15

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STEERING WHEEL ASSEMBLY WITH COVERED LIGHT SOURCE

CROSS REFERENCE TO RELATED APPLICATIONS

This application claims priority to and incorporates entirely by reference U.S. Provisional Patent Application Ser. No. 62/958,283 filed on Jan. 7, 2020 and entitled "LIGHT THROUGH LEATHER LIGHTBAR."

BACKGROUND

Conventional steering wheel lightbars are assembled by installing a housing, printed circuit board assembly (PCBA), thermal pad, diffuser film, brightness enhancement films, wire harness, and/or light guide onto a foamed armature/rim of the steering wheel assembly. The foamed armature is then wrapped in leather and/or other materials. Finally, a translucent lens is assembled to the leather wrapped foamed armature completing the lightbar assembly. Due to the difference in lens and leather material, the location and presence of the light guide is easily identifiable.

BRIEF SUMMARY

The present disclosure is directed to an illumination system for a steering wheel assembly of a vehicle. Various implementations include a housing coupled to a rim of the steering wheel assembly and at least one visible light source is disposed adjacent the housing. The visible light source emitting visible light through an opening in the housing and towards the vehicle occupant. A lens covers the opening in the housing such that an inner surface of the lens is disposed adjacent the opening in the housing. A cover material is provided that covers an outer surface of the lens and at least a portion of the rim, the cover material including translucent and/or transparent portions, wherein the lens is not visible through the cover material. Visible light from the visible light source passes through the transparent and/or translucent portions of the cover material.

In some implementations, the cover material includes opaque portions.

In some implementations, the cover material includes at least one of a translucent leather material, a translucent artificial leather material, and a translucent fabric material.

In some implementations, the translucent and/or transparent portions of the cover material are not visible until the visible light source is illuminated.

In some implementations, the visible light source, the housing, and/or the lens is not visible through the cover material.

In some implementations, any seam between an edge of the lens and the rim of the steering wheel assembly is not visible through the cover material.

In some implementations, the illumination system further includes a light guide received within the housing, where the at least one light source disposed adjacent the light guide. The light source is disposed adjacent at least one of a first end and a second end of the light guide, the light source emitting visible light into at least one of the first and second ends of the light guide through the light guide and out an outer surface of the light guide. The inner surface of the lens is disposed facing the outer surface of the light guide such that at least some of the light emitted from the outer surface of the light guide is directed toward the lens.

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In some implementations, the light guide and the housing have a corresponding arcuate shape, the arcuate shape of the housing and light guide corresponding to an arcuate shaped portion of the rim.

5 In some implementations, the visible light source is thermally coupled to a frame of the steering assembly such that the frame transfers heat from the visible light source toward the frame.

In some implementations, the lens is translucent.

10 In some implementations, at least a portion of the lens is opaque.

In some implementations, one or more light directing films are disposed in a path of the light emitted from the light source.

15 In some implementations, one or more light diffusing films and/or light enhancing films are disposed in a path of the light emitted from the visible light source.

In some implementations, at least one masking layer is coupled to the lens, the masking layer at least partially blocking and/or shaping a boundary of the light emitted from the visible light source and/or light guide when used.

20 In some implementations, a second housing is coupled to the housing, the second housing positioned around a circumference of the rim of the steering wheel assembly from the housing.

In some implementations, a plurality of housings are coupled to a front surface of the rim, wherein opposing ends of each of the plurality of housings are coupled to an adjacent housing such that the plurality of housings fully encircle a circumference of the rim.

In some implementations, the opposing ends of the plurality of housings are bonded together using at least one of a mechanical and a chemical fastener.

35 In some implementations, the bonded opposing ends of the plurality of housings are sanded after being bonded together to prevent appearance of a seam being visible through the cover material.

40 In some implementations, the housing and the light guide (when used) have a corresponding arcuate shape, the arcuate shape of the housing and light guide (when used) corresponding to an arcuate shaped portion of the rim.

In some implementations, the visible light source includes a plurality of individually controlled light sources positioned around at least a portion of a circumference of the rim of the steering wheel.

50 Various implementations of an illumination system for a steering wheel assembly of a vehicle comprise a housing coupled to a rim of the steering wheel assembly and a light guide received within the housing. A visible light source is disposed adjacent the housing and emitting visible light through an opening in the housing, the visible light source is provided adjacent an end surface of the light guide and emits visible light through the light guide and out the outer surface of the light guide. A lens is provided covering the light guide such that an inner surface of the lens is disposed facing an outer surface of the light guide. A cover material is provided covering an outer surface of the lens and at least a portion of the rim, wherein the cover material includes translucent and/or transparent portions. The light guide transmits visible light from the visible light source through at least a portion of the outer surface of the light guide, and the light from the outer surface of the light guide passes through the lens and the transparent and/or translucent portions of the cover material. The translucent and/or transparent portions of the cover material are not visible until the visible light source is illuminated.

In some implementations, the light source is an LED.

In some implementations, the light source includes a plurality of LEDs positioned around the circumference of the rim of the steering wheel.

BRIEF DESCRIPTION OF THE DRAWINGS

Example features and implementations are disclosed in the accompanying drawings. However, the present disclosure is not limited to the precise arrangements and instrumentalities shown. Similar elements in different implementations are designated using the same reference numerals.

FIG. 1 is a top partial cross section view of an example illumination system and steering wheel rim.

FIG. 2 is a partial front view of the illumination system and steering wheel rim of FIG. 1.

FIG. 3 is a top partial cross section view of an example illumination system and steering wheel rim.

FIG. 4 is a partial front view of the illumination system and steering wheel rim of FIG. 3.

FIG. 5 is a cross section view of the illumination system and steering wheel rim of FIG. 1 and/or FIG. 3 along section lines A-A.

FIG. 6 is a perspective view of the light bar of FIGS. 1-2.

FIG. 7 is a perspective view of the light bar of FIGS. 3-4.

FIG. 8 is a top partial cross section view of an example illumination system and steering wheel rim.

FIG. 9 is a partial front view of the illumination system and steering wheel rim of FIG. 8.

FIG. 10 is a top partial cross section view of the illumination system and steering wheel rim of FIG. 8.

FIG. 11 is a cross section view of the illumination system and steering wheel rim of FIG. 9 along section lines A-A.

FIG. 12 is a perspective view of the PCB and light source of FIGS. 8-11.

FIGS. 13-15 are partial front views of an example illumination system and steering wheel rim.

DETAILED DESCRIPTION

An object of the present disclosure is to provide a steering wheel assembly including an illuminated lightbar for display to vehicle occupant(s). As described here, the steering wheel includes a covering material that conceals the location and presence of a light source and/or lightbar. FIGS. 1 and 3 provide a top partial cross section view of an example illumination system 100 provided on a steering wheel rim. FIGS. 2 and 4 provide corresponding partial front views of each of the illumination systems. FIG. 5 provides a cross section view of the illumination system 100 and steering wheel rim of FIGS. 1-4 along section lines A-A. The illumination system 100 includes a housing 102 coupled to the rim 104/armature of the steering wheel. A light guide 106 is received within a housing 102. For example, as illustrated in FIG. 5, the light guide 106 is mounted on a base 120 portion of the housing 102. The base 120 can be formed with the housing 102 and/or separately formed and coupled to the housing 102. As provided in FIG. 5, the inner surface 126 of the light guide 106 is positioned adjacent the base 120 and the outer surface 128 is positioned facing the front surface (e.g., passenger facing surface) of the steering wheel assembly. A light source 108 can be disposed adjacent the light guide 106 such that the light source 108 emits light into the light guide 106. The light is then directed through the outer surface 128 of the light guide 106 and toward the front surface (e.g., passenger facing surface) of the steering wheel assembly. As illustrated in FIG. 5, the light is directed

through a light channel 118 towards an opening 116 in the housing 102. The light then passes through the lens 112 (from the inner surface 130 of the lens 112 to the outer surface 132 of the lens 112) and cover material 114 towards the vehicle occupant. As described in more detail below, the light channel 118 has straight opposing side walls for directing light from the light source 108 to the opening 116. As provided in FIG. 5, the opposing sides/walls of the light channel 118 are symmetrically shaped and similarly angled between the light source 108 and the opening 116.

In an example embodiment, the light source 108 includes at least one LED. The LED can be coupled to a PCB 110 for controlling its operation. The light source 108 can be thermally coupled to the rim 104 of the steering wheel assembly. For example, a heat dissipating material can be provided between the light source 108 and the rim 104 for transferring heat from the light source 108 to the rim 104. Example steering wheel assemblies including a heat dissipating material thermally coupled to a light element provided on the steering wheel rim are described in U.S. Patent Publication No. US 2014/0301097, which is herein incorporated by reference in its entirety. The light guide 106 and light source 108 can have a corresponding arcuate shape as the housing 102 with respect to the corresponding arcuate shape/curvature of the front surface (passenger facing surface) of the steering wheel assembly.

In other implementations, a light guide is not used. Instead, light is emitted from the light source directly towards the front surface (passenger facing surface) of the steering wheel assembly. As a result, the light visible to the occupant is brighter because it does not pass through a light guide before being directed toward the occupant. Additionally, this allows for a segmented and/or several individually operated light sources providing more customized display options, e.g., stationary or moving text, light effect, pattern, logo, graphic or other unique light display. FIGS. 8 and 9 provide top and front partial cross section views of an exemplary illumination system 100. The illumination system 100 includes a housing 100 coupled to the rim 104/armature of the steering wheel. FIG. 10 provides a partial top cross section view similar to FIG. 8, taken at a location closer to the perimeter of the steering wheel rim, closer to the 12 o'clock position, compared to the cross section view of FIG. 8. FIG. 11 is a cross section view of the illumination system 100 and steering wheel rim of FIGS. 8-10 along section lines A-A. As illustrated in FIG. 11, the light source 108 is coupled to a PCB 110 for directing its operation. FIG. 12 illustrates a perspective view of the PCB 110 and light sources 108 of FIG. 8-11. The light sources 108 are positioned along the length of the PCB 110. As provided in FIG. 12, the light sources 108 are arranged in an arcuate pattern corresponding to the arcuate shape of the PCB 110. The light source 108 (e.g., a top-firing LED) is positioned adjacent the housing 102 such that light emitted from the light source 108 is directed through the housing 102 and opening 116 toward the front surface (e.g., passenger facing surface) of the steering wheel assembly. The light is directed from the light source 108 through a light channel 118 towards opening 116. The light then passes through the lens 112 (from the inner surface 130 of the lens 112 to the outer surface 132 of the lens 112) and cover material 114 towards the vehicle occupant.

As provided in FIG. 11, the light channel 118 has a decreasing tapered shape between the light source 108 and the opening 116. In other examples, the light channel 118 can have an increasing tapered shape, a straight shape, or any other regular or irregular shape for directing light from

the light source **108** to the opening **116**. As provided in FIG. **11**, the opposing sides/walls of the light channel **118** are symmetrically shaped and similarly angled between the light source **108** and the opening **116**. In further examples, however, the opposing walls/sides of the light channel **118** can be differently shaped or angled between the light source **108** and the opening **116**. As illustrated in FIG. **5**, it is contemplated that the illumination system **100** of FIGS. **1-4** can have a similar cross section to the illumination system cross section as illustrated in FIG. **11**, e.g., including opening **116** and channel **118**.

In any of the illumination systems **100** described above, the housing **102** is used to secure the illumination system components to the steering wheel rim **104**. The housing **102** can include a single housing component extending around all or a portion of the circumference of the steering wheel rim **104**. Example steering wheel assemblies, including a light guide and associated housing, covering films, and lenses, are described in U.S. Pat. No. 9,233,638, and U.S. Patent Publication Nos. 2018/0208111 and 2016/0311366, which are herein incorporated by reference in their entireties.

In another example, the illumination system **100** can include a second housing coupled to the first housing **102**. The second housing can include the corresponding light source **108**, light guide **106** (when used), etc. The second housing positioned around the circumference of the rim **104** from the housing **102**. In another example, the illumination system **100** includes a plurality of housings coupled to the rim **104** (e.g., around the circumference of the rim **104** and along the front surface). Each of the plurality of housings **102** may include a corresponding light guide **106**, light source **108**, PCB **110**, etc. Where a plurality of housings **102** are included, opposing ends of each of the plurality of housings **102** can be coupled to adjacent housings **102** such that the plurality of housings **102** form a continuous member around the circumference (or portion thereof) of the rim. It is contemplated that several housings **102** can be provided and coupled together such that the plurality of housings **102** fully encircle/traverse the circumference of the rim **104**. The opposing ends of the plurality of housings **102** can be coupled and/or bonded together using any suitable mechanical and/or chemical fastener. The bonded ends of the housings **102** can be sanded or otherwise smoothed after being coupled/bonded together. The smoothing of the coupling point prevents the appearance of a seam (e.g., a seam between adjacent housings at the coupling point) from being visible through the cover material **114**.

A lens **112** is provided covering the light guide **106** and/or opening **116** in the housing **102**. In the example illumination system of FIGS. **1-5**, and as illustrated in FIG. **5**, the inner surface **130** of the lens **112** is disposed facing an outer surface of the light guide **106** such that an inner surface **130** of the lens **112** is oriented towards the light guide **106** and the outer surface **132** of the lens **112** is oriented away from the light guide **106** for directing light towards the front surface (passenger facing surface) of the steering wheel assembly. For example, the outer surface **132** of the lens **112** is oriented towards the passenger compartment of the vehicle such that light emitted from the light guide **106** and through the lens **112** is visible to vehicle occupants. In the example illumination system of FIGS. **8-11**, and as illustrated in FIG. **11**, the lens **112** is provided over the opening **116** in the housing **102** such that the inner surface **130** of the lens **112** is adjacent the opening **116** and the outer surface **128** of the lens **112** is orientated away from the light source **108**/opening **116** for directing light towards the front surface

(passenger facing) of the steering wheel assembly. As such, light emitted from the light source **108** and through the lens **112** is visible to the occupants.

In either embodiment, the lens **112** can be constructed from translucent material. In another example, at least a portion of the lens **112** can be opaque and/or transparent such that this portion of the lens **112** fully and/or partially blocks, masks, and/or shapes the boundary of the light emanating from the light source **108**. The opaque and/or transparent portion can be formed using a masking layer (e.g., paint, IML) applied to the lens **112**. Likewise, the masking/shaping of the light emanating from the light source **108** can be accomplished by use of a secondary component or material applied to the lens **112** or otherwise positioned between the light source **108** and the cover material **114**. It is contemplated that one or more light directing films can be disposed in the path of the light emitted from the light source **108**. For example, a light directing film can be provided between the light source **108** and the lens **112**, e.g., adjacent the light source **108**, adjacent the inner and/or outer surface **130**, **132** of the lens **112**. In the illumination system **100** of FIGS. **1-5**, a light directing film can additionally and/or alternatively be provided adjacent the light guide **106** (e.g., at the outer surface of the light guide **106**). One or more light diffusing films and/or light enhancing films can also be disposed in the path of the light emitted from the light source **108**. For example, a light diffusing and/or enhancing film can be provided between the light source **108** and the lens **112**, e.g., adjacent the light source **108**, adjacent the inner and/or outer surface **130**, **132** of the lens **112**. In the illumination system **100** of FIGS. **1-5**, a light diffusing and/or enhancing film can additionally and/or alternatively be provided adjacent the light guide **106** (e.g., at the outer surface of the light guide **106**). An example light guide system including various light lenses, diffusing films, and/or enhancing films is described in U.S. Patent Publication No. 2016/0025281, which is herein incorporated by referenced in its entirety.

In either embodiment, a cover material **114** is provided covering the outer surface **130**, **132** of the lens **112** and at least a portion of the outer surface of the steering wheel rim **104**. Example steering wheel assemblies including a lighted surface on the rim that is covered with a cover material are described in U.S. Pat. Nos. 7,934,439 and 8,136,425, which are herein incorporated by referenced in their entireties. As described above, the cover material **114** is used to prevent components of the illumination system **100** from being visible by the occupant from the exterior of the illumination system **100**. For example, the cover material **114** prevents the light guide **106**, the light source **108**, and the lens **112** from being visible when the light source **108** is not illuminated. Similarly, the cover material **114** also prevents a seam between the edge of the lens **112** and the rim **104** from being visible at any time. As such, the steering wheel appears to the occupant as a non-lit rim, with no visible indication of the internal illumination system components and no visible indication that the steering wheel assembly is different than any standard steering wheel assembly without an illumination system. However, as described in more detail below, when the light source **106** is illuminated, the emitted light passes through the cover material **114** and is visible to the occupant while the remaining internal illumination system components remain concealed.

The cover material **114** can include translucent and/or transparent portions that allow light emitted from the light source **108** to pass through the cover material **114** while preventing visibility of the internal illumination system

components. When the light source **108** is illuminated, light is transmitted through the housing and towards the lens **112**, passing through the lens **112** to the cover material **114**. When a light guide **106** is used, as in FIGS. **1-5**, the light source **108** is illuminated and the light guide **106** transmits the light from the light source **108** and through (at least a portion of) the outer surface of the light guide **106**.

The light then passes through the transparent and/or translucent portions of the cover material **114** and exits the steering wheel assembly. The cover material **114** can also include opaque portions that block light emitted from the light source **108** from passing through the cover material **114**. For example, the opaque and transparent/translucent portions can be used to form graphics, logos, or other unique patterns visible when the light source **106** is illuminated. The cover material **114** can be composed of at least one of a translucent natural leather material, a translucent artificial leather material, and/or a translucent fabric material. In some examples, the cover material **112** is composed of thin leather.

The cover material **114** can be used to diffuse or direct the light emitted from the light source **108**. For example, the cover material **114** can prevent the occupant from experiencing hot spots (undesirable areas of increased light intensity) or glare from the emitted light. Additionally, the cover material **114** can include a texture or surface treatment on the inner or outer surface of the cover material **114**. The texture or surface treatment alters the light passing through the cover material **114**. For example, the texture or surface treatment can be used to diffuse or direct the emitted light and prevent the occupant from experiencing glare or hot spots.

As illustrated in FIGS. **1, 3, and 6-7** the light source **108** can be disposed adjacent at least one end of the light guide **106**. In this example, light emitted from the light source **108** is projected into the side/end of the light guide **106** and then directed (via the light guide **106**) towards the outer surface of the light guide **106** and the lens **112**. FIG. **6** illustrates a perspective view of the light guide **106** of FIG. **1**. As provided in FIGS. **1 and 6**, the light source **108** is positioned adjacent a first end **122** of the light guide **106**. FIG. **7** illustrates a perspective view of the light guide **106** of FIG. **3**. As provided in FIG. **7**, the light source **108** is positioned adjacent both the first and second ends **122, 124** of the light guide **106**.

As illustrated in the illumination system **100** of FIG. **8**, the light source **108** is positioned to fire (e.g., illuminate) towards the front surface (passenger facing surface) of the steering wheel assembly. In addition, illumination system **100** allows for the use of multiple housing **102** segments, light sources **108** and/or light guides **106** positioned around the steering wheel rim **104**. As illustrated in FIGS. **8-12**, the example illumination system **100** can include multiple light sources **108** positioned along the rim **104** of the steering wheel assembly. Each of the light sources **108** can be coupled to corresponding PCBs **110** for controlling their operation. Alternatively, the light sources **108** can be coupled to a single PCB **110** for controlling their operation. Regardless of whether a single PCB **110** is used or multiple, it is contemplated that the operation of each of the individual light sources can be separately controlled. Individual control of the light source **108** improves the occupant's visual experience by controlling the brightness and clarity of the emitted light. It also allows for customized display options including stationary or moving text, light effect, pattern, logo, graphic or other unique light display. Example controlled light sources **108** for communicating with vehicle

occupants are described in U.S. Pat. Nos. 8,296,012, 9,308,856, 9,308,857, 9,520,061, 9,580,012, and U.S. Patent Publication Nos. 2016/0200246, 2016/0200343, which are herein incorporated by reference.

FIGS. **13-15** illustrate the exterior of the steering wheel assembly/rim **104** as visible to a vehicle occupant including various lighting designs that the light source **108** can cycle through. FIG. **13** illustrates the steering wheel assembly/rim **104** where the light source **108** is not illuminated. As described above, when the light source **108** is not illuminated the steering wheel appears to the occupant as a non-lit rim, with no visible indication of the internal illumination system components and no visible indication that the steering wheel assembly is different than any standard steering wheel assembly without an illumination system. As described above, by using multiple, individually controlled light sources **108**, preferably firing directly toward the occupant, as in FIGS. **8-12**, various stationary and/or moving patterns of the emitted light can be achieved. FIGS. **14 and 15** provide example illumination patterns of the light source **108**. FIG. **14** illustrates the steering wheel assembly/rim **104** with a red colored, bar-shaped pattern displayed on a portion of the rim **104**. FIG. **15** illustrates two green colored, bar-shaped patterns including a gradual/gradient fade in brightness toward the center of the rim. While these two patterns and colors are illustrated, it is contemplated that various other colors, patterns, shapes, and/or animations can be displayed using illumination system described herein.

The invention claimed is:

1. An illumination system for a steering wheel assembly of a vehicle, the illumination system comprising:
 - a housing coupled to a rim of the steering wheel assembly;
 - a visible light source disposed adjacent the housing and emitting visible light through an opening in the housing;
 - a lens covering the opening in the housing, an inner surface of the lens disposed adjacent the opening in the housing;
 - a cover material covering an outer surface of the lens and at least a portion of the rim, the cover material including at least one of a translucent portion, a transparent portion, or combinations thereof, wherein the lens is not visible through the cover material;
 - wherein visible light emitted from the visible light source passes through the transparent translucent portions of the cover material.
2. The illumination system of claim 1, wherein the cover material includes opaque portions.
3. The illumination system of claim 1, wherein the cover material includes at least one of a translucent leather material, a translucent artificial leather material, and a translucent fabric material.
4. The illumination system of claim 1, wherein the translucent portion and transparent portion of the cover material are not visible until the visible light source is illuminated.
5. The illumination system of claim 1, wherein the visible light source, the housing, and the lens are not visible through the cover material.
6. The illumination system of claim 1, where any seam between an edge of the lens and the rim of the steering wheel assembly is not visible through the cover material.
7. The illumination system of claim 1, further including:
 - a light guide received within the housing, the visible light source disposed adjacent the light guide,
 - wherein the visible light source is disposed adjacent at least one of a first end and a second end of the light

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guide, the visible light source emitting visible light through the light guide and out an outer surface of the light guide,

wherein the inner surface of the lens is disposed facing the outer surface of the light guide such at least some of the light emitted from the outer surface of the light guide is directed toward the lens.

8. The illumination system of claim 7, wherein the light guide and the housing have a corresponding arcuate shape, the arcuate shape of the housing and light guide corresponding to an arcuate shaped portion of the rim.

9. The illumination system of claim 1, wherein the visible light source is thermally coupled to a frame of the steering assembly such that the frame transfers heat from the visible light source toward the frame.

10. The illumination system of claim 1, wherein the lens is translucent.

11. The illumination system of claim 1, wherein at least a portion of the lens is opaque.

12. The illumination system of claim 1, further comprising one or more light directing films disposed in a path of the light emitted from the visible light source.

13. The illumination system of claim 1, further comprising at least one of a light diffusing film a light enhancing film, or a combination thereof, disposed in a path of the light emitted from the visible light source.

14. The illumination system of claim 1, further comprising at least one masking layer coupled to the lens, the masking layer at least partially blocking and at least partially shaping a boundary of the light emitted from the visible light source.

15. The illumination system of claim 1, further including a second housing coupled to the housing, the second housing positioned around a circumference of the rim of the steering wheel assembly from the housing.

16. The illumination system of claim 1, further comprising:

a plurality of housings coupled to a front surface of the rim, wherein opposing ends of each of the plurality of housings are coupled an adjacent housing such that the plurality of housings fully encircle a circumference of the rim.

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17. The illumination system of claim 16, wherein the opposing ends of the plurality of housings are bonded together using at least one of a mechanical and a chemical fastener.

18. The illumination system of claim 17, wherein the bonded opposing ends of the plurality of housings are sanded after being bonded together to prevent appearance of a seam being visible through the cover material.

19. The illumination system of claim 1, wherein the housing has an arcuate shape corresponding to an arcuate shaped portion of the rim.

20. The illumination system of claim 1, wherein the visible light source includes a plurality of individually controlled light sources positioned around at least a portion of a circumference of the rim of the steering wheel.

21. An illumination system for a steering wheel assembly of a vehicle, the illumination system comprising:

a housing coupled to a rim of the steering wheel assembly;

a light guide received within the housing;

a visible light source disposed adjacent an end surface of the light guide and emitting visible light through the light guide and out an outer surface of the light guide;

a lens provided over the light guide, an inner surface of the lens disposed facing the outer surface of the light guide,

a cover material covering an outer surface of the lens and at least a portion of the rim, the cover material including at least one of a translucent portion, a transparent portion, or a combination thereof;

wherein the light guide transmits visible light from the visible light source through at least a portion of the outer surface of the light guide, and the light from the outer surface of the light guide passes through the lens and the transparent and translucent portions of the cover material,

wherein the translucent and transparent portions of the cover material are not visible until the visible light source is illuminated.

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